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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/605,345	09/24/2003	Shyh-Ing Wu	10232-US-PA	2344

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JIANQ CHYUN INTELLECTUAL PROPERTY OFFICE		
7 FLOOR-1, NO. 100		
ROOSEVELT ROAD, SECTION 2		
TAIPEI, 100		
TAIWAN		

EXAMINER	
DOTY, HEATHER ANNE	

ART UNIT	PAPER NUMBER
2813	

NOTIFICATION DATE	DELIVERY MODE
07/19/2007	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USA@JCIPGROUP.COM.TW

Office Action Summary

Application No.

10/605,345

Applicant(s)

WU, SHYH-ING

Examiner

Heather A. Doty

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 February 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11, 13-21 and 23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-11, 13-21 and 23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 24 September 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- ☒ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This action is in response to the RCE and amendment filed 2/13/2007. Claims 1-11, 13-21, and 23 are pending in the application.

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 2/13/2007 has been entered.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 10 and 11 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 10 and 11 recite the limitation "the under-bump-metallurgy layer" in line 1 of each claim. There is insufficient antecedent basis for this limitation in the claim. The claims will be treated as best understood by the examiner.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-5, 7-9, 13-16, 18-21, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Degani et al. (U.S. 6,232,212) in view of Applicant's Admitted Prior Art (APA).

Regarding claim 1, Degani et al. teaches a process for forming a plurality of bumps on a wafer with an active surface, wherein the wafer further includes a passivation layer (oxide 12 in Fig. 1), a polymer layer (polyimide layer 14) and a plurality of bonding pads (13) over the active surface, and the bonding pads are exposed by a plurality of first openings in the passivation layer and the polymer layer (Fig. 1), the process comprising the steps of:

- forming an adhesion layer over the active surface of the wafer covering the bonding pads and the polymer layer (21 in Fig. 2; column 3, lines 40-45);
- forming a barrier layer on the adhesion layer (Cr/Cu layer 22; Degani et al. does not expressly refer to this layer as a barrier layer, but claim 1 does not limit the composition of this layer, so the examiner deems layer 22 equivalent to the claimed barrier layer);
- forming a wettable layer on the barrier layer (copper layer 23; column 3, lines 53-56);

- removing a portion of the wettable layer and a portion of the barrier layer such that the residual wettable layer and the residual barrier layer remain on the bonding pads (Fig. 4);
- forming a patterned mask layer, wherein the mask layer has a plurality of second openings that at least exposes the wettable layer (51 in Fig. 5);
- performing a process to form a solder paste layer inside the second openings by depositing solder paste into each second opening (62 in Fig 6; column 4, lines 60-65);
- performing a first reflow process to transform the solder paste layer inside each second opening into a bump while the adhesion layer still remains during performing the first reflow process (Fig. 7; paragraph bridging columns 4 and 5);
- removing the patterned mask layer, wherein the polymer is protected by the adhesion layer during removing the patterned mask layer (column 5, lines 9-18); and
- removing the adhesion layer outside the residual wettable and the residual barrier layer (Fig. 8).

Degani et al. does not teach that the process is a printing process wherein the solder paste layer is made of a mixture including solder powders and a flux, or performing a second reflow process to treat the bumps.

APA teaches a conventional method of fabricating bumps on an active surface of a wafer, comprising performing a printing process to deposit solder paste into openings

in a photoresist mask (paragraph 0006), wherein the solder paste layer is made of a mixture including solder powders and a flux (paragraph 0014).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to use the method taught by Degani et al., and further use a printing process to deposit solder paste made of solder powders and a flux, as APA teaches is conventional, since Degani et al. teaches using standard procedures of applying solder paste (column 4, lines 60-61).

Regarding claim 2, Degani et al. and APA together teach the method of claim 1. APA further teaches that after removing the adhesion layer outside the residual wettable layer and the residual barrier layer, it is conventional to further include a second reflow process to treat the bumps (paragraph 0013).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to further perform a second reflow process, as taught by APA, in order to complete formation of the bumps.

Regarding claim 3, Degani et al. and APA together teach the method of claim 1. Degani et al. further teaches that the adhesion layer is made of titanium (column 3, lines 41-45).

Regarding claims 4 and 5, Degani et al. and APA together teach the method of claim 1. Degani et al. further teaches that the step of removing the adhesion layer includes using an etching solution for removing the adhesion layer, wherein the etching solution for removing the adhesion layer does not react with the bumps (column 5, lines 19-25—the bumps are used to mask the etch, so do not react with the etching solution).

Regarding claim 7, Degani et al. and APA together teach the method of claim 1. Degani et al. further teaches that a material of the wettable layer comprises copper (column 3, lines 53-56).

Regarding claim 8, Degani et al. and APA together teach the method of claim 1. Degani et al. further teaches that the polymer layer is made of polyimide (column 3, line 1).

Regarding claim 9, Degani et al. and APA together teach the method of claim 1. Degani et al. further teaches that the bonding pads are made of aluminum.

Regarding claim 13, Degani et al. teaches a process of fabricating bumps on an active surface of a wafer, comprising the steps of:

- forming a first under-bump-metallurgy layer (21 in Fig. 4) on the active surface of the wafer (11);
- forming a second under-bump-metallurgy layer (23) on the first under-bump-metallurgy layer;
- removing a portion of the second under-bump-metallurgy layer (Fig. 4; column 4, lines 1-27);
- forming a patterned mask layer (51 in Fig. 5) over the first under-bump-metallurgy layer, wherein the mask layer has a plurality of openings that at least exposes the second under-bump-metallurgy layer (Fig. 5);
- performing a process to deposit a solder paste layer into the openings (62 in Fig. 6; column 4, lines 60-61);

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- performing a first reflow process to transform the solder paste layer inside the openings into bumps, wherein the first under-bump-metallurgy layer remains covering over the active surface of the wafer while performing the first reflow process (Fig. 7); and
- removing the first under-bump-metallurgy layer outside the residual second under-bump-metallurgy layer (Figs. 8 and 9; column 5, lines 19-25).

Degani et al. does not teach that the process is a printing process wherein the solder paste layer is made of a mixture including solder powders and a flux, or performing a second reflow process to treat the bumps.

APA teaches a conventional method of fabricating bumps on an active surface of a wafer, comprising performing a printing process to deposit solder paste into openings in a photoresist mask (paragraph 0006), wherein the solder paste layer is made of a mixture including solder powders and a flux (paragraph 0014).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to use the method taught by Degani et al., and further use a printing process to deposit solder paste made of solder powders and a flux, as APA teaches is conventional, since Degani et al. teaches using standard procedures of applying solder paste (column 4, lines 60-61).

APA further teaches that it is conventional to perform a second reflow process to complete formation of a bump (paragraph 0013).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to further perform a second reflow process, as taught by APA, in order to complete formation of the bump.

Regarding claims 14 and 15, Degani et al. and APA together teach the method of claim 13. Degani et al. further teaches that the second under-bump-metallurgy layer at least comprises a wettable layer, wherein a material of the wettable layer comprises copper (column 3, lines 53-55).

Regarding claim 16, Degani et al. and APA together teach the method of claim 14. Degani et al. further teaches that the step of forming a second under-bump-metallurgy layer on the first under-bump-metallurgy layer further includes the steps of:

- forming a barrier layer (Cr/Cu layer 22 in Fig. 4; Degani et al. does not expressly refer to this layer as a barrier layer, but claim 1 does not limit the composition of this layer, so the examiner deems layer 22 equivalent to the claimed barrier layer) on the first under-bump-metallurgy layer; and
- forming the wettable layer on the barrier layer (layer 23 is on top of layer 22 in Fig. 4)

Regarding claims 18 and 19, Degani et al. and APA together teach the method of claim 13. Degani et al. further teaches that the first under-bump-metallurgy layer includes an adhesion layer, wherein the adhesion layer is made of titanium (column 3, lines 41-45).

Regarding claims 20 and 21, Degani et al. and APA together teach the method of claim 19. Degani et al. further teaches that the step of removing the adhesion layer

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includes using an etching solution for removing the adhesion layer, wherein the etching solution for removing the adhesion layer does not react with the bumps (column 5, lines 19-25—the bumps are used to mask the etch, so do not react with the etching solution).

Regarding claim 23, Degani et al. and APA together teach the method of claim 13. Degani et al. further teaches that the wafer includes a polymer layer disposed over the active surface, and the first under-bump-metallurgy layer is disposed on the polymer layer (polyimide layer 14 in Fig. 1; column 3, line 1).

Claims 6, 10, 11, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Degani et al. (U.S. 6,232,212) in view of Applicant's Admitted Prior Art (APA) as applied to claims 9 and 16 above, and further in view of Higdon et al. (U.S. 6,375,062).

Regarding claims 10 and 11, Degani et al. and APA together teach the process of claim 9, but do not teach that the under-bump-metallurgy layer is an aluminum/nickel-vanadium alloy/copper composite layer when the bonding pads are made of aluminum or a titanium/nickel-vanadium alloy/copper composite layer when the bonding pads are made of copper.

Higdon et al. teaches a solder bumping method that uses either aluminum (column 4, lines 34-35) or copper bonding pads (column 4, lines 37-38), wherein it is particularly suitable to use either an aluminum/nickel-vanadium alloy/copper layer or a titanium/nickel-vanadium alloy/copper composite layer for the under-bump-metallurgy layer (column 4, and 54-60).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to form a solder bump according to the process taught by APA and Lu et al. together, and also taught by claim 9, and further make the bonding pads of aluminum and the under-bump-metallurgy of aluminum/nickel-vanadium alloy/copper or to make the bonding pads of copper and the under-bump-metallurgy of titanium/nickel-vanadium alloy/copper composite. The motivation for doing so at the time of the invention would have been that Higdon et al. teaches that this under-bump-metallurgy layer is particularly suitable in bump-forming processes. Further, it has been held that the selection of a known material based on its suitability for its intended use supports a prima facie obviousness determination (*Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945)).

Regarding claims 6 and 17, Degani et al. and APA together teach the method of claims 1 and 16, but do not teach that a material of the barrier layer includes nickel-vanadium alloy.

Higdon et al. teaches that nickel-vanadium alloy is a particularly suitable material for a barrier layer in under-bump metallurgy layers (column 4, lines 54-60).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to use the method taught by Degani et al. and APA together, and further use a nickel-vanadium alloy for the barrier layer, since Higdon et al. teaches that it is a particularly suitable material for a barrier layer in under-bump metallurgy layers.

Response to Arguments

Applicant's arguments with respect to claims 1-11, 13-21, and 23 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Heather A. Doty, whose telephone number is 571-272-8429. The examiner can normally be reached on M-F, 9:30 - 2:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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